FRENCH'S

Scientific Timber Cruiser

A COMPENDIUM OF

Valuable Information for Cruisers or Estimators of Timber, Sawyers, Millmen or Owners of Timber Lands

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PUBLISHED BY

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PREFACE

Thousands of men for centuries have desired to know the art of cruising timber, or, in other words, know to a certainty the number of feet of boards that could be sawn from the timber standing on their holdings, but up to this time there has been no "hard and fast" rule through which this knowledge might be attained.

Men have scaled the logs prior to sawing, have watched them as they were being reduced to lumber and have tallied the number of feet thereof and in time offered their services as "Timber Cruisers," and have been employed through the understanding that they were able to estimate timber, but in every instance it has been "a guess." They had no set rule by which they could demonstrate their figures.

This book will tell you how to find the number of feet of boards any tree will saw out, and by knowing the number of trees per acre, that number, times the average number of feet in a tree, will give you the number of feet per acre.

As this system is intended for the "amateur" as well as the "expert," I have endeavored to make the wording and explanations so plain that anyone may understand it.

Very respectfully,

T. R. FRENCH.

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LAND SURVEYS OF THE UNITED STATES

Land in the United States is laid off into Townships (six miles square), containing 23,040 acres; Sections (one mile square), containing 640 acres; Quarter-sections (one-half mile square), containing 160 acres, and Quarter Quarter-sections (one-quarter mile square), containing 40 acres.

The law provides that all excesses or deficiencies, either from erroneous measurements or bearings or from the convergence of meridians, shall, so far as possible, be thrown into the northern and western quarter-sections of the township.

Corner monuments have been established on all United States land surveys at all the corners of townships, sections, quarter-sections and meandered lines, except at the point common to four-quarter sections, at the center of each section.

These monuments are of various composition, as

(a) A stone with pits and earth mound.
(b) A stone with a mound of stone.
(c) A stone with bearing trees.
(d) A post in a mound of stone.
(e) A post in a mound of earth.
(f) A post with bearing trees.
(g) A mound without post or stone.
(h) A tree without bearing trees.
(i) A tree with bearing trees.

Whenever possible, certain descriptive marks and letters are cut on the stones, posts and trees, such as described in the following sample field notes. It

should also be stated, that any of the styles of marking above-named may be used for any kind of corner, and that the styles described below are not limited to the purposes there named.

STANDARD TOWNSHIP CORNERS

For illustration: I will take a township corner that is marked with a stone and two bearing trees.

The stone is set at the corner of Township 13 North, Ranges 21 and 22 East, and is marked S. C. on North side, with 6 grooves on the North, East, and West faces.

The Bearing Trees are two trees (usually a rod or so distant from the corner) and the tree standing on section 31 in this case will be marked as follows: T 13 N R 22 E S 31 B T.

The Bearing Tree on section 36 will be marked as follows: T 13 N R 21 E S 36 B T.

Often the four township corners do not come together, on account of variations in surveying. When they do, there would be four bearing trees instead of two, and each one would give the township, range, and section on which they stood.

SECTION CORNERS

Section corners can be designated by a post 4 inches square and four feet long, being two feet in the ground, and scribed with the number of the township, and adjoining sections on the sides facing them.

For instance: We will set a stone in the ground

for the corner of sections 9, 10, 15 and 16, marked with 4 notches on South, and 3 notches on the East faces, from which we have 4 bearing trees, one on each section, and they read as follows:

T 2 N R 2 W S 10 B T.—Meaning Township 2 North Range 2 West, Sec. 10, B. T.

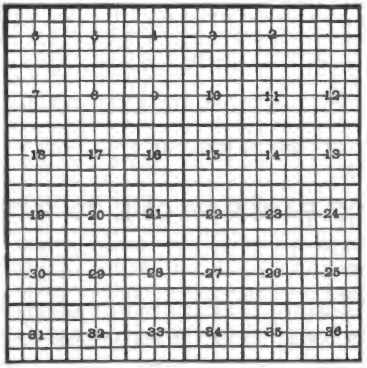
T 2 N R 2 W S 15 B T.—Meaning Township 2 North, Range 2 West, Sec. 15, B. T.

T 2 N R 2 W S 16 B T.—Meaning Township 2 North, Range 2 West, Sec. 16, B. T.

T 2 N R 2 W S 9 B T.—Meaning Township 2 North, Range 2 West, Sec. 9, B. T.

B. T.—Meaning "Bearing Tree."

QUARTER SECTION CORNERS



Quarter-section posts are 3 feet long, 3 inches square, and 12 inches in the ground, and marked ¼ S. on the North (or West) face.

In cruising timber, or running section or township lines, it is always absolutely necessary to know on

what degrees of the compass the original survey was made. This can always be found out from any surveyor.

All lines with legal corner boundaries are marked after this method, viz: Those trees which may be intersected by the line will have two blazes or notches cut on the sides facing the line, without any other marks whatever. These are called sight trees or line trees.

MODE OF LAYING OFF SMALL LOTS OF LAND

2½ acres is 400 square rods, or 20 rods square, or 330 feet each way.

1 acre is 160 square rods, or 12.65 rods square, or 208 7/10 feet each way.

½ acre is 80 square rods, or 8.94 rods square, or 147½ feet each way.

1/3 acre is 53 1/3 square rods, or 7.30 rods square, or 120½ feet each way.

¼ acre is 40 square rods, or 6.324 rods square, or 104⅝ feet each way.

⅛ acre is 20 square rods, or 4.475 rods square, or 73¾ feet each way.

NUMBER OF PACES IN ONE TO EIGHTY RODS

6¼	paces of 31 68/100 inches equals	1 rod
62½	paces of 31 68/100 inches equals	10 rods
125	paces of 31 68/100 inches equals	20 rods
250	paces of 31 68/100 inches equals	40 rods
500	paces of 31 68/100 inches equals	80 rods

TO FIND THE DIAMETER OF A STANDING TREE AT THE BUTT

Divide the circumference by 3.1416. This will give the diameter outside the bark. If the bark, for instance, is 3 inches thick, then you have 6 inches of bark, therefore deduct 6 inches from your

diameter, and you have the diameter inside the bark. The same rule applies to the top measure.

Often trees have what is called swell, or churn butts. A proper allowance should always be made in obtaining the diameters of such trees.

CANADIAN LANDS

"Crown lands" shall mean and include such ungranted Crown or public lands or Crown domain as are within and belong to His Majesty in right of the Province and whether or not any waters flow over or cover the same.

"CROWN GRANT"

"Crown grant" shall mean any instrument in writing under the Public Seal of the Province conveying land in fee simple.

Crown Grant or Patent gives absolute ownership in fee simple to land and timber thereon, and on the timber or logs taken from land covered by deeds issued prior to the 7th of April, 1887, there is a tax or export duty of from $1.00 to $4.00 per thousand feet, which is refunded if the logs are manufactured into lumber in Canada. On all timber cut on deeded Crown Grant Lands issued since the 7th of April, 1887, and prior to March 12th, 1906, there is a royalty of 50 cents per thousand feet, and no tax. Both these classes are exportable.

On any timber cut from Crown Lands or from Grown Granted Lands deeded since March 12th, 1906, there is a royalty of 50 cents per thousand,

but the logs are not exportable and must be sawn in Canada. The lumber, of course, can be exported.

DOMINION LEASES

Dominion Government leases were issued by the Federal Government at Ottawa up to 1908, for timber standing within twenty miles either side of the Canadian Pacific Railway, since when all Dominion lands are reserved indefinitely. Dominion leases give the holder the right of all the timber on the land held under lease until cut. The charges on the same are as follows: A ground rent of 5 cents per acre per year in advance, and stumpage or royalty of 50 cents per thousand when cut. There is a charge of fire dues which is too small to take into consideration.

PROVINCIAL LEASES

Prior to 1905 the Provincial Government, which controls all the timber of British Columbia, outside of the Canadian Pacific Railway belt, issued leases covering timber lands, which gave the holder of such leases the right to all the timber on the lands covered by the lease for a period of twenty-one years, with a ground rental of 10 cents per acre per year and 50 cents per thousand stumpage when cut. These leases can be surrendered at any time and renewed for another twenty-one years under existing laws in force at time of surrendering. Leases are subject to the law at time of issue.

SPECIAL PROVINCIAL LICENSES

The Provincial Government, up to 1908, issued Special Provincial licenses, good for twenty-one years from date of issue, which gave the holder the right to all the timber on the land for twenty-one years at a ground rental of $140.00 per annum per section of 640 acres, and 50 cents per thousand stumpage when cut. East of the Cascade Range the charge is $115.00 per annum per section of 640 acres, with a stumpage of 60 cents per thousand when cut.

At the beginning of 1908 all Provincial timber was reserved by the Government indefinitely, so that at the present time no timber can be procured in the province of British Columbia from either Government.

All leases and licenses are transferable.

By an act of Parliament April, 1910, "Every special timber license shall be transferable and shall be renewable from year to year while there is on the land included in such license merchantable timber in sufficient quantity to make it commercially valuable." This makes all Special Provincial Timber Licenses perpetual, so long as the yearly license fee of $140.00 is paid, and this should be paid on or before October 31st of each year. Anyone owning Special Provincial licenses can have them transferred or renewed by surrendering his old license and all privileges appertaining thereto within two years from the first day of April, 1910.

By this act the twenty-one year license is made in perpetuity or perpetual.

TIMBER LIMITS

"Timber Limits shall mean lands specified and comprised in any timber license."

"LEGAL POST"

"Legal Post" shall mean a stake standing not less than four feet above the ground and squared or faced on four sides for at least one foot from the top, and each side so squared or faced shall measure at least four inches on its face so far as squared or faced, and any stump or tree cut off and squared or faced to the above height or size; Provided, when the survey is made, the center of the tree or stump where it enters the ground shall be taken as the point to or from which measurement shall be made.

"PATENTED LANDS"

"Patented Lands" shall mean lands granted by the Crown during the period commencing on the 7th day of April, A. D. 1887, and ending on the 28th day of April, A. D. 1888.

"TIMBER LEASEHOLD"

"Timber Leasehold" shall mean lands included in timber leases granted after the 31st day of December, 1879, and lands included in any timber lease hereafter granted.

PLAN OF TOWNSHIPS

The Crown Lands, where such a system is practicable, shall be laid off and surveyed into quadrilateral townships, containing thirty-six sections, of one mile square in each, by lines running astronomically North and South, crossed by others running astronomically East and West, as shown below.

SECTIONS, HOW TO BE NUMBERED

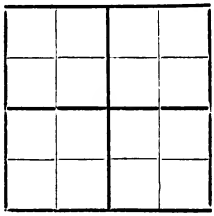
31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

(2) The sections shall be numbered as shown in the above diagram.

(3) Quarter-section corners shall be established equidistant between the section corners, except on the section lines closing on the North and West boundaries of Townships, on which they are set at forty chains from the last section corner, and ex-

cess or deficiency of measure, if any, shall be carried out into the last half mile, and cast upon the North and West sides of the Township.

(4) The quarter-sections composing every section may be divided into quarter quarter-sections of forty acres each, and such quarter quarter-sections may be styled legal subdivisions, bounded and numbered as shown in the following diagram:



Surveyed lots of 640 acres may be subdivided into quarters, and quarter quarters, in the same manner as the subdivision of sections and quarter-sections.

(5) The dimensions and area of the irregular quarter-sections shall in all cases be returned by the Surveyor at their actual measurements and contents.

(6) All sections shall be closed by first running a random line East or West, as the case may be, to intersect the opposite corresponding corner post. Should this random line not intersect the post, then the distance shall be measured and a correct line run (care being taken to note the course) East or West, as the case may be, upon which the quarter-

section post shall be established. East and West lines must close with one hundred links.

(7) All lines shall be run to the cardinal points of the compass.

SECTION POSTS

Section posts shall not be less than four inches square, four feet out of the ground, and scribed with the number of the township and adjoining sections on the sides facing them.

QUARTER-SECTION POSTS

Quarter-section posts shall not be less than three inches square, three feet out of the ground, and marked ¼ S.

All posts shall be squared two feet from the top, except half section posts, which shall be flattened only on two sides.

Posts shall be pointed on top to shed the water.

In prairies, posts shall have mounds raised round them to a height of at least two feet six inches, either of earth or stones, and the posts to be scribed with the number of Township and Section on each side.

Mounds shall be three feet square at base. At a distance of one foot from each side of each mound a trench shall be dug at least two feet wide and one foot deep.

On rocks, or where it is impossible to sink posts, they shall be surrounded by a cairn of rocks at least thirty inches high, the base to be three feet square.

Four bearing trees shall be taken for every post, the trees being marked B. T. with distance from post, and faced towards the post.

The lines through timber shall be thoroughly blazed, two blazes to be made on each tree quartering on the line, so as to be easily distinguished and traced.

No tree shall be blazed at a greater distance than six feet on either side of the line.

All line trees shall be notched with three notches on each side in the direction of the line, and their size, kind of timber, and distance from the last section corner shall be given in field notes.

Lands in Canada are laid off the same as in the United States, but the numbering of the sections is directly the opposite from those in the United States. "The Surveyor shall commence the survey of each township at the southeast corner, and complete the eastern tier of sections, viz: Nos. 1, 12, 13, &c., first; then return to the southern boundary of the township and complete the second tier of sections, viz: 2, 11, 14, &c., and so on until the township is completed."

TO MEASURE THE HEIGHT OF A TREE

Walk on level ground to a distance from the foot of the tree or object about equal to its presumed height. Lie on your back on the ground, stretched at full length. Let an assistant note on a perpendicular staff at your feet the exact point where your line of vision to the top of the object crosses the staff. Measure the height of this, B C, and your own height to your eyes, A B. Then as A B, B C, A D, D E.

Example: The distance from my eyes to my feet is 5 feet 6 inches; from the ground to where the line of vision crosses the staff is four feet; from the point where my eyes were to the foot of the tree is 90 feet, what is the height of the tree?

Answer: As 5½:4::90:about 65 feet, the height of the tree (Multiply 90 by 4 and divide it by 5½) 5.5.

Another way: When a tree stands so that the length of its shadow can be measured, its height can

be readily ascertained as follows: Set a stick upright—let it be perpendicular by the plumb line. Measure the length of the shadow of the stick. Then, as the length of the shadow of the stick is to the height of the stick, so is the length of the shadow of the tree to the height of the tree.

For example: If the height of the stick is four feet and its shadow six feet in length, and the length of the shadow of the tree ninety feet, then 6:4::90 (60) or sixty feet, the height of the tree. In other words, multiply the length of the shadow of the tree by the height of the stick, and divide by the length of the shadow of the stick.

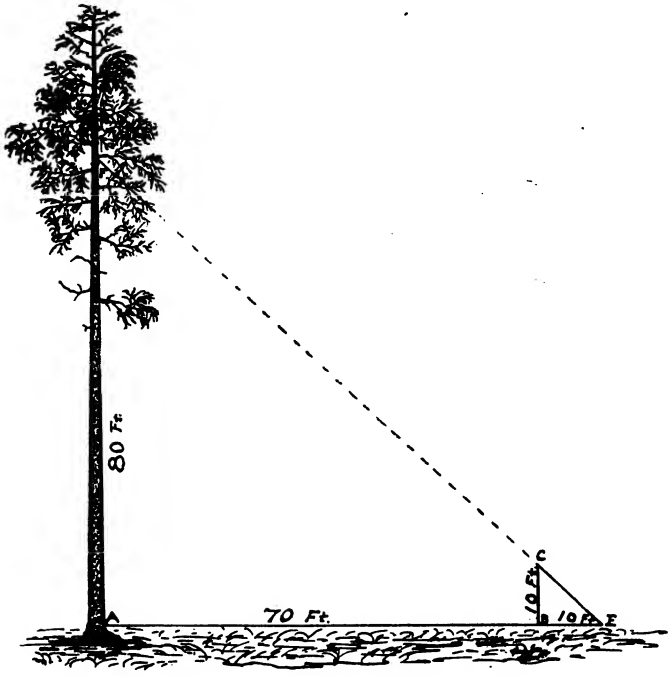
(By permission of publisher of Scribner's Lumber and Log Book.)

HOW TO FIND THE HEIGHT OF A TREE

Another Way: In looking at a tree, suppose you say, "I think the height of that tree from the ground to where it would be cut off at the top, is 100 feet." Now measure off on level ground at right angles, 100 feet from the base of the tree, then measure 10 feet back, and put your 10-foot pole at (b). Have it perpendicular. Then put your eye at (e), looking over the top of the pole at (c), and where the eye strikes the tree at (f), will be 100 feet from (a). You can then allow the height of the stump, by deducting it from the height of the tree.

Your pole should be three or four inches over 10 feet above the ground, for in placing your eye at

(e) your eye would naturally be a few inches from the ground, so a few inches variation at (e) would



make several feet at (f), or the top of the tree.

N. B.—This rule will apply to any tree, or any height. The principles hold true in any case.

(By permission of Publisher of Conklin's Commercial Calculator.)

Another Way: Stand a pole of any length up

against the tree you wish to know its height; then go from the tree, say one or two hundred feet. Stand another pole on the ground in front of you and hold it at arm's length. Holding the pole in your left hand, you take one or two fingers of your right hand, holding them horizontally against the pole in your left hand, and adjust your eyes so in looking over the top and bottom of your fingers, you can just see the top and bottom of the pole at the tree. Now move your fingers up the width of them, which equals the height of the pole at the tree, and as many times as you move your fingers up, the tree is that many times the height of the pole standing against the tree.

For instance, if the pole against the tree was 20 feet long, and you moved your fingers up four times, the height of the tree would be 80 feet.

With a little care you can come very close to the height.

HOW TO CRUISE TIMBER

The Way to Estimate the Number of Feet (Board Measure) an Acre or Tract of Timber Will Saw Out

First, do not let your desire to find a great abundance of timber on your holdings outweigh your better judgment and cause you to over-reach the bounds of reason. Make it a few thousand feet less, rather than too many. You should know what you have, rather than what you think you have.

The most accurate method of finding the height of timber you wish to cruise, is to find a number of fallen trees, selecting several that will represent as nearly as possible the average size of the timber standing.

Ascertain the length of each tree up to where it would be topped, and by adding together their combined lengths and dividing the amount thus obtained by the number of trees, this will give you the average height. Now find their combined diameters at the middle (of each tree) by adding them together and dividing them by the number of trees. This will give the average diameter of the timber.

Ordinarily you will get a more accurate size of the diameter of a tree by measuring it at the center, than you will by adding the diameters of butt and top together and dividing by 2, for often the butt

or trunk is extraordinarily large and out of proportion to the balance of the tree.

This system is based on the fact that .8862 represents and stands for a round log or tree, and this is so because by multiplying the diameter of the tree at the center (half way from butt to top) by .8862, you get the side of a square stick of timber equalling in area or substance the actual number of cubic inches or feet that the round log or tree contains; therefore we call .8862 the perfect tree or log, as the case may be.

As a certain portion of the tree must always be allowed for saw-dust in manufacturing, also breakages, conk, punk or rot, in estimating timber, and not knowing whether the logs will be sawn into inch or thicker lumber, nor whether they will be sawn by band or circular saws, I have demonstrated and think it unwise to use more than 6½ as a base or multiplier; so by multiplying the diameter of the tree at the center by 6½ or .65 you get one side of a square stick of timber; having the same size from butt to top, and by reducing this stick of timber to feet, board measure, you have what the log or tree will saw out into boards or lumber.

The diameter must always be taken from the middle of the tree.

Having found the average diameter at the center, you multiply this diameter by 6½, and this will give one side of a square stick of timber. For instance: If a tree is 150 feet in length from butt to where it

will be cut off at top, and the diameter is found at the center to be 50 inches, then multiply this diameter (50 inches) by 6½, which will give you 32½. You now have a stick of timber 32½ by 32½—150 feet long. Now square 32½, by multiplying 32½ by 32½ and divide the amount by 12, and you have 88 feet, which is 88 feet for every foot in length. Multiply this (88) by 150, the length of the tree, and you have 13,200, the amount of feet the tree will saw out into lumber. No doubt any good tree of this size would saw out more than this amount, but in estimating timber you should always allow something for timber broken in falling, as well as conk, punk, rot or other defects, and this rule allows for that unless the conditions are too bad. This rule is for standing timber and not for logs at the mill.

For another illustration we will take a tree 60 feet in length, and we find the diameter at the center, or 30 feet from the butt, to be 15 inches. Multiply the diameter (15) by 6½, or you can multiply the circumference by twenty (20), and you have a stick of timber 9¾ by 9¾—60 feet long. Therefore 9¾ multiplied by 9¾ by 60, and divided by 12, will give you 8 feet per foot, or 480 feet, the amount the tree will saw out.

An acre of land is 208 7/10 square feet, therefore after you have satisfied yourself as to the average size and height of the timber, and you desire to know how much timber there is on any certain acre, you start from some designated spot and pace off 104

feet, or half the distance across one side of an acre, and stand facing the acre you wish to cruise. Therefore you will look 104 feet on each side of you and 208 feet in front, which will contain a piece of land 208 feet square, or one acre.

You will now count the merchantable trees on this acre. If it is difficult to correctly count them so far away, then count them only 104 feet in front of you and double the number so obtained to get what stands on one acre. Now multiply the average feet in one tree by the number of trees on the acre, and the result will be the number of feet on the acre.

In cruising large tracts of timber, the Estimator or Cruiser has what is called a Compassman to run the line. The corner of the land to be cruised must first be located, and for explanation will say, that we will begin at the south-west corner of Section 31. As our object is to cruise the timber standing on the South-West quarter of the South-West quarter of Section 31, the Compassman will stand at the corner facing north. The Cruiser steps off 10 rods, or 62½ paces due east on the south line of the forty, and will also face the north. The Compassman being on the line, both he and the Cruiser start north; the Compassman following the line and counting his steps, while the Cruiser estimates or counts the trees ten rods on each side of him as he advances.

At the end of the first twenty rods, or 125 paces, the Compassman calls out "Tally one." The

Cruiser in going the twenty rods will have counted the trees or estimated the timber on a piece of land twenty rods square, or two and a half acres.

As he has kept tally of each particular kind of timber as he advanced, he makes a notation of this in a book for that purpose, and this is kept up for every twenty rods until the Compassman calls out "Tally four." Thus he has gone four tallies of 125 paces each, or across the forty acres—80 rods. Both men now being on the north line of the forty, they both step off 125 paces, or 20 rods, due east, and facing south, return to the south line of the forty, and so on until the whole forty acres has been cruised.

The Cruiser always endeavors to keep ten rods from his Compassman.

By cruising each 2½ acres, all marshes, streams and where timber grows scantily may be noted, and as the trees are carefully counted you get as accurate an estimate as it is possible to get.

The great secret is to know the amount of lumber the average tree contains, and then count your timber.

When you cannot find any fallen timber by which to obtain a reasonably accurate average of size and height, then resort to the methods on pages 17, 18 and 19. You cannot guess accurately the height of a tree. Heights are very deceptive, especially in Western Fir, Hemlock, Larch and Cedar. In some cases a tree with 48 inches diameter at the butt will attain a height from 250 to 300 feet, while in other

localities the same diameter will not be over 150 feet in height. Thus it is necessary to fully know the average size and height. By measuring the circumference of the butts of standing trees and even finding a down tree here and there, you can get a very good average of the height and size of the timber. Measurements must be inside of the bark.

Care should be taken in cruising Cedar, as it is usually rotten at the butt, and much so in large timber.

Don't try to get the "very last tree" on an acre, for there are always more or less defects you cannot see, and you surely want it to cut out up to your estimate, whether you are buying or selling.

NUMBER OF FEET PER FOOT IN ANY TREE

This table shows the number of feet per lineal foot the different diameters of trees at the middle will saw out by the rule of 6½. The length of the tree in feet, multiplied by the number of feet per foot will give you the number of feet the tree contains.

Diameter in Center.	Per Ft.	Diameter in Center.	Per Ft.
6 inches	1¼ ft.	44 inches	68 ft.
7 inches	1½ ft.	45 inches	71 ft.
8 inches	2¼ ft.	46 inches	75 ft.
9 inches	3 ft.	47 inches	78 ft.
10 inches	3½ ft.	48 inches	81 ft.
11 inches	4¼ ft.	49 inches	85 ft.
12 inches	5 ft.	50 inches	88 ft.
13 inches	6 ft.	51 inches	92 ft.
14 inches	7 ft.	52 inches	95 ft.
15 inches	8 ft.	53 inches	99 ft.
16 inches	9 ft.	54 inches	103 ft.

Diam. in Center	Per Ft.	Diam. in Center	Per Ft.
17 inches	10 ft.	55 inches	107 ft.
18 inches	11 ft.	56 inches	110 ft.
19 inches	13 ft.	57 inches	114 ft.
20 inches	14 ft.	58 inches	119 ft.
21 inches	16 ft.	59 inches	123 ft.
22 inches	17 ft.	60 inches	127 ft.
23 inches	19 ft.	61 inches	131 ft.
24 inches	20 ft.	62 inches	135 ft.
25 inches	22 ft.	63 inches	139 ft.
26 inches	24 ft.	64 inches	144 ft.
27 inches	26 ft.	65 inches	149 ft.
28 inches	28 ft.	66 inches	153 ft.
29 inches	30 ft.	67 inches	158 ft.
30 inches	32 ft.	68 inches	163 ft.
31 inches	34 ft.	69 inches	168 ft.
32 inches	36 ft.	70 inches	173 ft.
33 inches	38 ft.	71 inches	178 ft.
34 inches	41 ft.	72 inches	183 ft.
35 inches	43 ft.	73 inches	188 ft.
36 inches	46 ft.	74 inches	193 ft.
37 inches	48 ft.	75 inches	198 ft.
38 inches	51 ft.	76 inches	203 ft.
39 inches	54 ft.	77 inches	208 ft.
40 inches	56 ft.	78 inches	214 ft.
41 inches	59 ft.	79 inches	220 ft.
42 inches	62 ft.	80 inches	225 ft.
43 inches	65 ft.		

Do not compare these figures with any log scale, as the diameters above shown are taken at the center of the log, while the scale rules measures the log at the small end.

TABLE SHOWING CIRCUMFERENCE OF ANY LOG

From 20 to 300 Inches, With Diameter of the Same.

Circum. is	Diameter is	Circum. is	Diameter is
20 inches	6¼ inches	140 inches	44 inches
22 inches	7 inches	142 inches	44½ inches
24 inches	7½ inches	144 inches	45¼ inches
26 inches	8¼ inches	146 inches	45¾ inches
28 inches	9 inches	148 inches	46½ inches
30 inches	9½ inches	150 inches	47 inches
32 inches	10 inches	152 inches	47¾ inches
34 inches	10¾ inches	154 inches	48 inches
36 inches	11½ inches	156 inches	49 inches
38 inches	12 inches	158 inches	49½ inches
40 inches	12½ inches	160 inches	50 inches
42 inches	13¼ inches	162 inches	50¾ inches
44 inches	14 inches	164 inches	51½ inches
46 inches	14½ inches	166 inches	52 inches
48 inches	15¼ inches	168 inches	52¾ inches
50 inches	15¾ inches	170 inches	53½ inches
52 inches	16½ inches	172 inches	54 inches
54 inches	17 inches	174 inches	54¾ inches
56 inches	17½ inches	176 inches	55½ inches
58 inches	18¼ inches	178 inches	56 inches
60 inches	19 inches	180 inches	56½ inches
62 inches	19½ inches	182 inches	57 inches
64 inches	20 inches	184 inches	57¾ inches
66 inches	20¾ inches	186 inches	58½ inches
68 inches	21¼ inches	188 inches	59 inches
70 inches	22 inches	190 inches	59¾ inches
72 inches	22¾ inches	192 inches	60¼ inches
74 inches	23¼ inches	194 inches	61 inches
76 inches	24 inches	196 inches	61½ inches
78 inches	24½ inches	198 inches	62¼ inches
80 inches	25¼ inches	200 inches	62¾ inches
82 inches	25¾ inches	202 inches	63½ inches
84 inches	26½ inches	204 inches	64¼ inches
86 inches	27 inches	206 inches	65 inches
88 inches	27¾ inches	208 inches	65½ inches
90 inches	28¼ inches	210 inches	66 inches

Circum is	Diameter is	Circum. is	Diameter is
92 inches	29 inches	212 inches	66¾ inches
94 inches	29½ inches	214 inches	67½ inches
96 inches	30¼ inches	216 inches	68 inches
98 inches	31 inches	218 inches	68¾ inches
100 inches	31½ inches	220 inches	69¼ inches
102 inches	32 inches	222 inches	70 inches
104 inches	32¾ inches	224 inches	70½ inches
106 inches	33¼ inches	226 inches	71¼ inches
108 inches	34 inches	228 inches	71¾ inches
110 inches	34½ inches	230 inches	72½ inches
112 inches	35 inches	235 inches	74 inches
114 inches	35¾ inches	240 inches	75½ inches
116 inches	36½ inches	245 inches	77 inches
118 inches	37 inches	250 inches	78¾ inches
120 inches	37¾ inches	255 inches	80¼ inches
122 inches	38¼ inches	260 inches	82 inches
124 inches	39 inches	265 inches	83½ inches
126 inches	39½ inches	270 inches	85 inches
128 inches	40 inches	275 inches	86½ inches
130 inches	40¾ inches	280 inches	88 inches
132 inches	41½ inches	285 inches	89½ inches
134 inches	42 inches	290 inches	91 inches
136 inches	42¾ inches	295 inches	92½ inches
138 inches	43¼ inches	300 inches	94 inches

TAMARACK PILING

Following table computed on a weight of 4,500 lbs. to the thousand feet, B. M.

The diameter of piling at the center is found by adding together the top and butt diameters, and dividing by two.

In these tables, the actual feet of timber, board measure, per foot is given. There is nothing taken out for saw-dust or slab. It is as though you had a log of putty and had molded it into a square stick of timber, and then found the number of feet.

To find the number of inches a log will square, which would give you the side of an equal square,

that is, giving you a square stick of timber containing the same number of cubic inches or cubic feet of lumber that is contained in the round log, you multiply the diameter in the middle of the log by .8862 (a decimal). Then multiply the width of this timber by the thickness, dividing that by 12. This will give you the number of feet (board measure) there are in one lineal foot. To find the number of feet in the whole stick, you multiply the length in feet by the number of feet per foot or pounds, as the case may be.

To find the number of pounds a lineal foot will weigh, multiply the number of feet per foot by the weight per thousand feet.

The following tables are very convenient in computing the cost of freight when making a delivered price on piling, etc.:

Dia. in Center.	Per Lin. Ft.	Weight, Per Lin. Ft.
7 inches	3 1/5 feet	14 pounds
8 inches	4 1/5 feet	19 pounds
9 inches	5 3/7 feet	24 pounds
10 inches	6 1/2 feet	29 pounds
11 inches	7 9/10 feet	35 pounds
12 inches	9 3/8 feet	42 pounds
13 inches	11 feet	50 pounds
14 inches	12 4/5 feet	58 pounds
15 inches	14 3/4 feet	66 pounds
16 inches	16 3/4 feet	75 pounds
17 inches	18 3/4 feet	85 pounds
18 inches	21 1/4 feet	95 pounds
19 inches	23 1/2 feet	106 pounds
20 inches	26 feet	117 pounds
22 inches	32 feet	144 pounds
24 inches	38 feet	171 pounds

FIR PILING

Computed on a Weight of 3,500 Pounds Per 1,000 Feet, Board Measure

The same instructions relative to Tamarack piling apply to Fir, etc.

Dia. in Center.	Per Lin. Ft.	Weight, Per Lin. Ft.
8 inches	4 1/5 feet	14¾ pounds
9 inches	5 3/7 feet	18 pounds
10 inches	6 1/2 feet	23 pounds
11 inches	7 9/10 feet	28 pounds
12 inches	9 3/8 feet	33 pounds
13 inches	11 feet	39 pounds
14 inches	12 4/5 feet	45 pounds
15 inches	14 3/4 feet	51 pounds
16 inches	16 3/4 feet	58 pounds
17 inches	18 3/4 feet	66 pounds
18 inches	21 1/4 feet	74 pounds
19 inches	23 1/2 feet	82 pounds
20 inches	26 feet	91 pounds
22 inches	32 feet	111 pounds
24 inches	38 feet	132 pounds

Green White Pine, Norway Pine and Fir weigh about the same amount to the cubic foot. Green Hemlock will weigh about 4,000 lbs. to the thousand feet. Oak, 5,200 lbs.

A VALUABLE TABLE

The diameter of a circle or log, multiplied by .8862 equals side of an equal square.

The circumference of a circle or log, multiplied by .2821 equals side of an equal square.

The diameter of a circle or log, multiplied bq .7071 equals side of an inscribed square.

The circumference of a circle or log, multiplied by .2251 equals side of an inscribed square.

The square of the circle of a circle or log, multiplied by .07928 equals the area.

The area of a circle or log, multiplied by .6366 equals side of the inscribed square.

The side of a square multiplied by 1.4142 equals diameter of its circumference circle.

The side of a square multiplied by 4.443 equals circumference of its circumference circle.

(To multiply the side of any square timber by 1.4142 will give you the diameter of a round log from which the timber could be taken.)

The side of a square multiplied by 1.128 equals diameter of an equal circle.

The side of a square multiplied by 3.545 equals circumference of an equal circle.

To find the surface of a sphere or globe, multiply the diameter by the circumference.

To find the solidity of a sphere, multiply the square of the diameter by 3.1÷16.

To find the solidity of a shaft or cylinder, multiply the area of one end by the length.

WHAT IS THE SIDE OF AN EQUAL SQUARE?

It is the side of the greatest square that can be made from a circle, and equals the area of the circle. It is as though you had a log of putty and you pressed it into a square timber. It would contain the same number of cubic inches that the log would contain, and the weight of each would be the same.

Q. How may I find the side of an equal square, or the size of this square stick of timber from any log?

Ans. Multiply the diameter in the center by .8862, or the circumference by .2821. By so doing you will have every cubic inch or cubic foot in the timber that the log contained, and the size of the stick will be the same from end to end.

By this rule, if you are shipping logs or piling, you can tell exactly how many actual feet every stick contains, and if you know what the usual weight of such timber is, you can tell how much every log or pile weighs.

On page 30 you will find a table giving the diameters of piling from 7 to 24 inches, showing the number of feet and weight per lineal foot according to above rule.

Example: What will be the size of an equal square from a log 18 inches in diameter at the center?

Answer: Multiply the diameter 18 by .8862 and you have 16 inches, or a stick 16 x 16. If you wish to know how many feet there are in each lineal foot, multiply 16 by 16, and divide by 12. Then multiply the number of feet in one foot by the length of the

log or timber, and you have every foot board measure the log contains, no matter what the length might be.

Multiplying the diameter by .8862, or the circumference by .2821, will bring the same result.

The center or middle of a log means the top and butt diameters added together and divided by 2, or diameter of the log half way between butt and top.

WHAT IS AN INSCRIBED SQUARE?

It is the greatest square that can be contained in a circle.

Multiplying the small end of any log by 7 will give in inches what the log will square without any bark on the edges. For instance, a log 20 inches in diameter at the small end will square or saw out a stick of timber 14 by 14, or in other words 14 inches square.

If you wish to know the largest square stick of timber you can get out of a log, multiply the diameter at the small end by 7.

WEIGHTS OF WOOD, EARTH, IRON AND STONE

Cast Iron, per cu. ft.	450 lbs.
Water, per cu. ft.	62½ lbs.
White Pine, dry, per cu. ft., ab't.	30 lbs.
White Oak, dry, per cu. ft., ab't.	50 lbs.
Loose Earth, per cu. ft.	95 lbs.
Gravel, per cu. ft.	115 lbs.
Common Soil, per cu. ft.	124 lbs.
Clay, per cu. ft., about	135 lbs.
Clay with stones, per cu. ft.	160 lbs.
Marble, per cu. ft.	166 lbs.
Granite, per cu. ft.	169 lbs.
Brick, per cu. ft.	125 lbs.

Lead ..... 708¾ Copper ..... 486¾ Brass 555

RAILWAY TIES

Number Per Mile

16 inches from center to center, 3960 ties
18 inches from center to center, 3520 ties
21 inches from center to center, 3017 ties
24 inches from center to center, 2640 ties
27 inches from center to center, 2348 ties
30 inches from center to center, 2113 ties
33 inches from center to center, 1921 ties
36 inches from center to center, 1761 ties

GRADE PER MILE

This table shows the grade per mile as indicated below:

An incline of 1 foot in 1 is 5280 feet per mile
An incline of 1 foot in 2 is 2640 feet per mile
An incline of 1 foot in 3 is 1760 feet per mile
An incline of 1 foot in 4 is 1320 feet per mile
An incline of 1 foot in 5 is 1056 feet per mile
An incline of 1 foot in 6 is 880 feet per mile
An incline of 1 foot in 8 is 660 feet per mile
An incline of 1 foot in 10 is 528 feet per mile
An incline of 1 foot in 15 is 352 feet per mile
An incline of 1 foot in 20 is 264 feet per mile
An incline of 1 foot in 25 is 211 feet per mile
An incline of 1 foot in 30 is 176 feet per mile
An incline of 1 foot in 35 is 151 feet per mile
An incline of 1 foot in 40 is 132 feet per mile
An incline of 1 foot in 45 is 117 feet per mile
An incline of 1 foot in 50 is 106 feet per mile
An incline of 1 foot in 75 is 70 feet per mile
An incline of 1 foot in 100 is 53 feet per mile
An incline of 1 foot in 125 is 42 feet per mile
An incline of 1 foot in 150 is 35 feet per mile

PERCENT OF GRADE

1 per cent. grade is 53 feet per mile
2 per cent. grade is 106 feet per mile
3 per cent. grade is 158 feet per mile
4 per cent. grade is 211 feet per mile
5 per cent. grade is 264 feet per mile
6 per cent. grade is 317 feet per mile

7	per cent.	grade is	370	feet	per mile
8	per cent.	grade is	422	feet	per mile
9	per cent.	grade is	475	feet	per mile
10	per cent.	grade is	528	feet	per mile
11	per cent.	grade is	581	feet	per mile
12	per cent.	grade is	634	feet	per mile
13	per cent.	grade is	686	feet	per mile
14	per cent.	grade is	739	feet	per mile
15	per cent.	grade is	792	feet	per mile
16	per cent.	grade is	845	feet	per mile
17	per cent.	grade is	898	feet	per mile
18	per cent.	grade is	950	feet	per mile
19	per cent.	grade is	1003	feet	per mile
20	per cent.	grade is	1056	feet	per mile
21	per cent.	grade is	1109	feet	per mile
22	per cent.	grade is	1161	feet	per mile
23	per cent.	grade is	1214	feet	per mile
24	per cent.	grade is	1267	feet	per mile
25	per cent.	grade is	1320	feet	per mile

WATER-PROOF LEATHER PRESERVATIVE

"Take one pint of boiled linseed oil, half a pound mutton suet, six ounces clean bees-wax, and four ounces rosin; melt and mix over a fire, and apply while warm. A good way is to put it on with a brush, and warm it in well." Fine for Cruiser boots.

UNIV. OF MICHIGAN,

JUN 7 1913